Automated Real-Time Clearance Analyzer (ARCA), Phase I Project

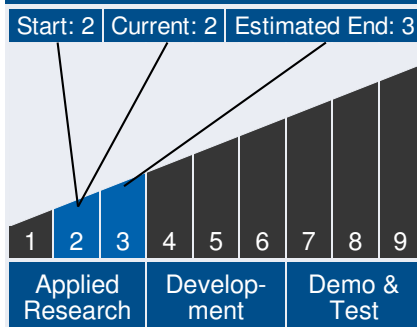SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

The Automated Real-Time Clearance Analyzer (ARCA) addresses the future safety need for Real-Time System-Wide Safety Assurance (RSSA) in aviation and progressively more trusted autonomy as will be explored in NASA's SMART-NAS and SASO within the Airspace Operations and Safety Program (AOSP). ARCA builds on recent advances in probabilistic (Bayesian) network modeling and the rapid expansion of big data capabilities. The application of ARCA that we propose to develop, ARCA-A, performs safety analyses of approach clearances based on multiple sources of relevant real-time data, such as real-time aircraft data, weather data, past and current operations data, and crew data. ARCA-A provides intelligent risk assessment of clearances over the lifetime of the operation, from planning to clearance delivery. As it matures, ARCA can play a range of roles at increasing levels of autonomy and authority. Initially, once it has trained to the level of generating insight, it can be used to identify hot spots in the NAS or in a region (specific areas, procedures, aircraft types, or times of day when risks increase) on a daily or weekly review basis. Next, it could be deployed to air traffic managers, dispatchers, or other users with real-time operational oversight. With further integration, it could optionally display real-time informational warnings on ATC displays, flight displays, or dispatcher screens. Eventually, ARCA could play a foundational role in automated clearance selection and delivery. For research purposes, in this project we propose to design and begin development of a specific ARCA-A application. The primary focus of the research will be core algorithms, information integration, performance, and feasibility. ARCA is a promising new concept that represents a major step forward in aviation safety from static, forensic, manual methods toward real-time, prognostic, automated capabilities, the end result of which will be safer and more efficient operations.

Table of Contents

Technology Maturity

Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

Program Manager:
- Carlos Torrez

Automated Real-Time Clearance Analyzer (ARCA), Phase I Project

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The Automated Real-Time Clearance Analyzer (ARCA) could be a Real-Time System-Wide Safety Assurance (RSSA) component in NASA's SMART-NAS project within the Airspace Operations and Safety Program (ASOP). ARCA could also be an element of future NASA concept systems (simulations, prototypes, research studies) for ATC, ATM, flight decks, and/or flight operations centers. ARCA could evolve into any or all of the following: a decision support tool for controllers or pilots, a real-time monitor for flight dispatchers, or an aggregator for useful periodic reporting (by airport, runway, time period, etc.). SBIR Phase I focuses on the essential design and proof-of-concept demonstration. Phase II will create a working prototype capability incorporating multiple sources into a real-time analysis of a potential approach clearance. This prototype and derivatives of it could be instrumental to NASA RSSA research, exploring both real-time safety concepts in general as well as specific decision support automation. Beyond core algorithm research and development, we envision ARCA expanding its reach into real-time information access using big data technology and becoming integrated into end-user systems. We expect ARCA capabilities to be synergistic with NASA research in these areas.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Potential commercial applications of the Automated Real-Time Clearance Analyzer (ARCA) include future systems for Fleet Operators, ANSPs (such as the FAA), and the flight deck. Fleet operators have a unique and powerful interest in operational safety. ARCA-A technology would give them a tool to continuously analyze approach procedures and the associated risk levels. This in turn can inform very impactful decisions, such as what procedures are planned, requested by pilots, and supported by the operators. In the near/mid-term, ARCA could give operators or

Management Team *(cont.)*

Principal Investigator:
- David Rinehart

Technology Areas

Primary Technology Area:
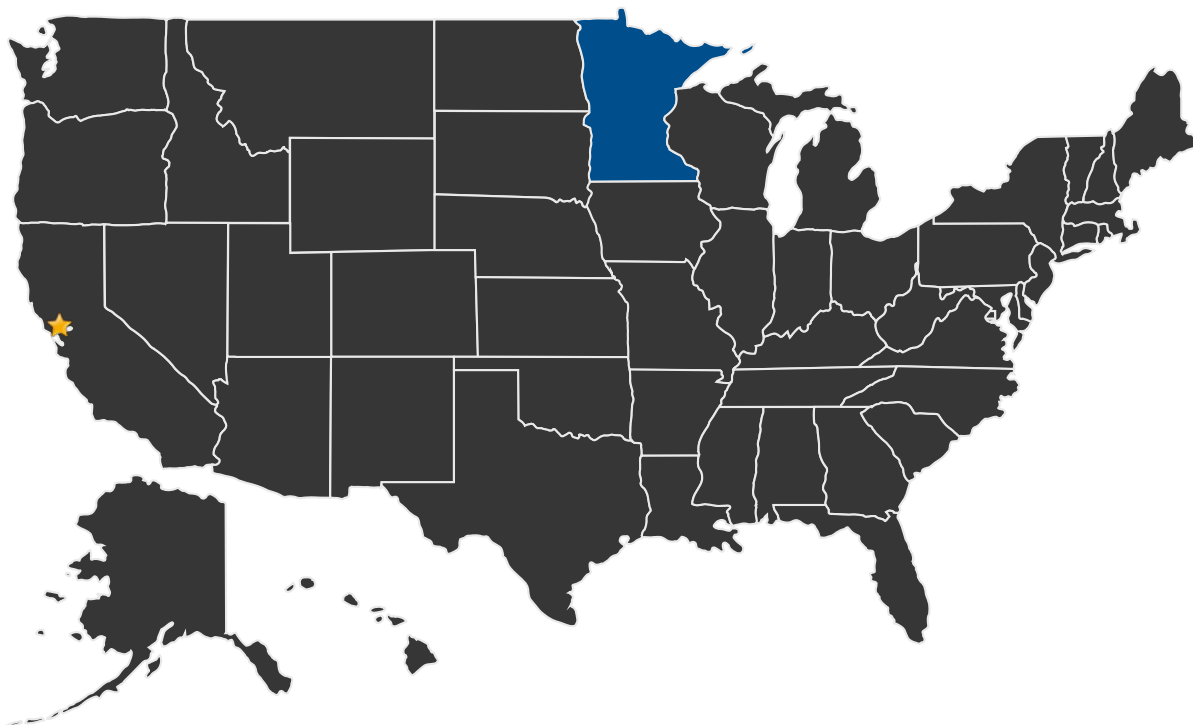Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)

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SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ANSPs an initial capability to start assessing, flagging and tracking risk factors associated with the approach clearance. The FAA could start looking at trends NAS-wide in approach clearance risks (e.g. what areas and procedures are highest/lowest risk) and evaluate ARCA technology as part of ATM/ATC real-time decision support tools. ARCA could also be adapted to the flight deck to intelligently assist pilots. In the far-term picture, ARCA lays the foundation for approach clearance automation (e.g. automation generates and delivers context-appropriate approach clearances with human supervision). As real-time safety is a concern for all aviation stakeholders, ARCA capabilities are relevant to multiple future commercial applications.

U.S. WORK LOCATIONS AND KEY PARTNERS

■ U.S. States With Work   ⭐ **Lead Center:**
Ames Research Center

Other Organizations Performing Work:

- ARCHITECTURE TECHNOLOGY CORPORATION (Eden Prairie, MN)

PROJECT LIBRARY

Presentations

- Briefing Chart
    - (http://techport.nasa.gov:80/file/23485)

IMAGE GALLERY

Automated Real-Time Clearance Analyzer (ARCA), Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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